Wetlands

Methodology. Impacts to wetlands were determined by overlaying conceptual design drawings of each alternative on base maps that delineated and classified wetlands within the project area. Wetland locations were delineated and described in a wetland delineation report produced for the project area (NPS 1997). Maps produced for this study served as the wetland base maps.

In locations where roads were removed, constructed, or modified, permanent impacts to wetlands were calculated by the Federal Highway Administration, Eastern Federal Lands Highway Division, and expressed in square feet; these estimates were later converted to hectares and acres. The road widths used to determine wetland impacts (including the road surface, shoulders, and additional clearing required for construction) were similar to those identified under vegetation. However, in wetland areas clearing beyond the road shoulders would be minimal; therefore, actual road widths or the area between the limits of construction would be less. Reduced clearing areas were considered in determining wetland impacts.

The intensity of the resulting impacts on wetlands were determined based on the wetland acreage permanently filled (or restored) and the size, integrity, and connectivity of the wetland impacted.

Size — The severity of a loss of wetland acreage depends on the size of the wetland impacted. A small area of impact in a large wetland would be likely to have less of an effect than would a large area of impact in a small wetland. The change in size of a wetland, as a result of an impact, would also influence the integrity and connectivity of the wetland and vice versa.

Integrity — Highly intact wetland areas with little prior disturbance would be more susceptible to impacts from direct development than would a wetland area previously degraded by development or other activities. The loss of function and productivity of the higher quality wetland would be a greater loss than that of a lower quality wetland. Additionally, indirect impacts due to human trampling or a change in vegetation or hydrology would also impact the integrity of a wetland.

Connectivity — The relationship of wetlands to other wetlands and other valuable natural resources is also important in determining the degree of impact. Plant communities that are isolated from each other are less productive and functional than those that are connected. Narrow, pervious trail corridors that are infrequently or seasonally used would have less fragmenting effect than would a wide hard-surface roadway with high volumes of vehicular or pedestrian traffic. Buildings and other structures also provide barriers to the natural dispersal of plants and animals.

The following definitions of impact intensity are similar to those identified in other natural resource sections, but have been modified slightly to include the effects of size, integrity, and connectivity.

Negligible — No measurable or perceptible changes in wetland size, integrity, or continuity would occur.

Minor — The impact would be measurable or perceptible, but slight. A small change in size, integrity, or connectivity of the wetland could occur. However, the overall viability of the resource would not be affected. Left alone, the wetland would recover, and the impact would be reversed.

Moderate — The impact would be sufficient to cause a measurable change in one of the three parameters (size, integrity, or connectivity of the wetland) or would result in a small, but permanent, loss or gain in wetland acreage.

Major — The impact would result in a measurable change in all three parameters (size, integrity, or connectivity) or a permanent loss or gain of large wetland areas. The impact would be substantial and highly noticeable.

These intensities may describe either adverse or beneficial effects. Adverse impacts would result from the permanent filling or clearing of wetlands; beneficial impacts from the removal of obstructions such as roads or structures that often fragment wetland systems.

Impact Analysis. A total of 0.7 hectare (1.7 acres) of palustrine forested, scrub/shrub, and emergent wetlands would be permanently filled as a result of constructing the parkway motor road, relocating Old Agency Road, and constructing the crossover road from Old Agency Road to Old Agency Road Relocated. Table 1 identifies the potential adverse or beneficial impacts to wetland areas 1 through 10 (see “Affected Environment” for location).

Impacts have been analyzed assuming that mitigations would be in place (see page x). All wetlands would be flagged before construction, and all construction activity would avoid these areas to the extent possible. Where roads were developed through wetlands, no disturbance would take place outside the construction limits of the project, and measures necessary to protect the integrity of the wetland would be implemented. Some of these measures would include using temporary erosion control devices and redirecting flowing and intermittent streams through culverts during construction. Selective clearing in wetlands would be permitted, provided stumps were not grubbed and ground disturbance was avoided.

Long-term, adverse impacts would occur in wetland areas 2, 4, 6, 8, and 9 because of cuts or the placement of fill to construct new roadbeds and shoulders. The remaining wetland areas (1, 3, 5, 7, and 10) would not be adversely affected in the long term, although some short-term impacts such as soil compaction and damage to wetland vegetation could occur as equipment and workers constructed new roads. Some beneficial, long-term impacts would occur to wetland areas 5 and 7 because existing roads would be removed and areas restored.

The parkway motor road would impact a small corner on the northern edge of wetland 2; the open water portion of this wetland would not be impacted. Less than 1% of the palustrine scrub/shrub portion of this wetland would be impacted, resulting in negligible impacts to the overall function and value of the wetland.

The parkway motor road and Old Agency Road Relocated would impact approximately 26% of wetland 4 and 45% of wetland 6, resulting in a combined reduction of these two wetlands

TABLE 1: WETLAND IMPACTS, REVISED PROPOSED ACTION

1	0	0	No impact
2	<0.01 ha (<0.01 ac.)	<1	Negligible adverse
3	0	0	No impact
4 and 6	0.4 ha (1.1 ac)	40	Major adverse
5	0	0	Minor beneficial
7	0	0	Minor beneficial
8	<0.1 ha (0.2 ac)	14	Moderate adverse
9	0.2 ha (0.4 ac)	13	Moderate adverse
10	0	0	No impact

by 40%. The parkway motor road alignment would impact approximately 0.3 hectare (0.9 ac.) of wetland 6, the greatest amount of impact. Old Agency Road Relocated would impact approximately 0.04 hectare (0.1 ac.) of wetland 6 in the southern portion of the project area. Wetlands 4 and 6 are interconnected in the southern section of the project area near the Dinsmor subdivision. The development of the parkway motor road and Old Agency Road Relocated would sever wetlands 4 and 6 into four or five separate areas, resulting in a long-term, major adverse impact. Although the local hydrology could be maintained through the use of culverts, the loss and fragmentation of wetland plant communities would impair their integrity and reduce the overall function and value of these wetlands. Loss and fragmentation of these wetlands would reduce their overall ability to provide flood storage, groundwater discharge and recharge, as well as their overall function to provide cover and habitat for wildlife.

The parkway motor road and the new crossover road between Old Agency Road and Old Agency Road Relocated would impact the northwestern edge of wetland 8. Old Agency Road Relocated would also impact a small section of wetland 8 in the southern portion of the project area. Combined impacts to this wetland would be less than 0.1 hectare (0.2 ac.). Long-term impacts to this wetland would be moderate, with a loss of 0 and habitat for wildlife. Hydrology could be maintained through the use of a culvert.

Palustrine emergent wetlands associated with wetland 9 would be impacted in the southern section of the project area as a result of Old Agency Road Relocated. Approximately 13% of this wetland would be impacted. Long-term impacts would be moderate. Old Agency Road Relocated would reduce the overall ability of this wetland to provide flood storage and habitat for small mammals and birds.

In wetland areas 5 and 7 the removal of road surfaces, road fill, shoulders, and culverts could enhance the integrity and connectivity of wetland areas. Where roads were proposed for removal, disturbed areas outside the stream channels would be restored to the original contours and revegetated with native species. Stream channels could be returned to their natural state, and the local hydrology could be maintained or restored if necessary. Such restoration activities could result in minor to moderate beneficial impacts to the wetland systems.

The 0.7 hectare (1.7 ac.) of wetlands impacted would consist of approximately 0.4 ha (1.1 ac.) of palustrine forested wetlands, 0.1 ha (0.2 ac.) of palustrine scrub/shrub wetlands, and 0.2 hectare (0.4 ac.) of palustrine emergent wetlands.

Based on the NPS wetland protection guidelines *(DO 77-1: Wetland Protection)*, a statement of findings is required to implement this alternative due to adverse impacts to wetlands. The draft “Statement of Findings” is included in appendix E for public and agency review. Any comments on the statement of findings will be incorporated following the release of this *Final Supplemental Environmental Impact Statement*. The final signed statement of findings will be attached to the record of decision for this project.

Cumulative Impacts. Another section of parkway motor road must be constructed immediately to the west of project 3P13 to complete this portion of the Natchez Trace Parkway. Referred to as project 3P13-West, this project would cause an additional 0.6 hectare (1.5 ac.) of wetlands to be permanently filled. A separate statement of findings is being prepared for this project. The total impact on wetlands for both projects would be the long-term loss of 1.3 hectares (3.2 ac.) of wetlands.

A 21-mile, paved multi-use trail has been proposed along the Natchez Trace Parkway, including the area of project 3P13 (see page **Error! Bookmark not defined.** for more details). No trail bridges are proposed along this segment of the parkway; thus it is assumed that culverts would be placed in areas where the trail would cross drainages. Fill and excavation operations associated with establishing the trail grade and placing culverts would impact additional wetlands. A statement of findings will be prepared and attached to the final environmental assessment for impacts associated with the multi-use trail. Wetland impacts and proposed mitigations would be identified in that statement of findings.

Conclusion. Approximately 0.7 hectare (1.7 ac.) of wetlands would be permanently filled to construct new roads. Long-term, major adverse impacts would occur to wetlands 4 and 6, resulting in up to a 40% reduction in the size of the combined wetland areas and dividing the wetlands into four or five separate areas. Long-term, moderate adverse impacts would occur to wetlands 8 and 9. Negligible adverse impacts would occur to wetland 2. No adverse impacts would occur to wetlands 1, 3, and 10. Removing roads could provide opportunities to improve wetland systems in areas 5 and 7. Developing remaining parkway sections to the west would result in an additional loss of 0.6 ha (1.5 ac.) of wetlands and a cumulative wetland impact of 1.3 ha (3.2 ac.).

WATER QUALITY

Methodology

Averages of creel surveys for Rainy Lake were used to determine the number of craft-hours that houseboats use this lake. Rainy Lake accounts for 42 commercial houseboats, and the average number of days (dividing craft-hours by number of commercial houseboats) shows that each boat is used about an average of 49 days. This is not a precise number, but an estimate, since creel surveys do not differentiate between private and commercial boats.

Currently, 92 commercial houseboats serve the Rainy and Namakan basins. Creel surveys show houseboats on Rainy Lake have spent an average of nearly 50,000 craft-hours total each year since 1996 (1996–1999 Rainy Lake creel surveys, NPS unpublished information). This translates to about 49 days (or 7 weeks) per houseboat. Houseboats are outfitted with freshwater tanks of 80–200 gallons. This analysis assumed 90% of this freshwater leaves the boat as graywater, and that one tank serves the boat for the entire week. In other words, each boat emits up to 180 gallons/week of graywater.

No actual data are available on the number of motorized boats using the park's lakes. However, creel surveys conducted by the Minnesota Department of Natural Resources and the National Park Service count the number and type of boats and hours they spend on east and west Rainy Lake each year. The most recent creel survey of angler hours on Kabetogama and Namakan Lakes was conducted in 1999. The counts are randomly stratified with respect to time of day, and therefore they give a statistically sound estimate of the mean number of boats or anglers on the lakes during the season.

A number of assumptions were made in calculating the volume of oil-gas mixture emitted into the lakes each year. Unpublished information from the Minnesota Department of Natural Resources on watercraft use of the park's four large lakes in 1999 was compiled to determine the number of hours boats were in use. The same number of craft-hours as given above in "Air Quality" were used. The literature (California EPA, 1999; Martin 1999; NPS 1998a) indicated two-stroke engines emit 25–46% of fuel into exhaust, and use fuel at an average rate of 10 gallons per hour (Martin 1999) or 10% of the horsepower rating (in gallons per hour) at full throttle (park staff, pers. comm. Dec. 1999). In the absence of data, half the motorized boats on the lake were assumed to use 100 HP engines, and half 25 HP engines. They were assumed to be at full throttle 25% and 80% of the time respectively. Oil-gas emissions at full throttle were assumed to average 25% and were assumed to be zero when boats were at idle or at RPMs slower than full throttle. All motorized watercraft were assumed to be two-stroke engines in 1999, but beginning in the year 2000, 5% per year were assumed to change to either fuel injection or four-stroke engines. Either of these shifts was assumed to result in a 50% reduction in emissions. The number of craft-hours was assumed to increase at ½% per year, the same as the predicted increase in visitor numbers.

Concentrations above standards imposed for the protection of aquatic wildlife were assumed to be “readily detectable” and therefore moderate adverse impacts. Those above drinking water standards were assumed to be potentially major impacts. Those within standards but detectable were defined as minor, and those below the limits of detection, negligible. In the absence of quantitative data, best professional judgment prevailed.

Regulations — Water Quality/Water Resources

Minnesota has designated waters in the park as “outstanding resource value waters.” This means no one can cause or allow a new or expanded discharge of any sewage, industrial waste, or other waste into the park’s lakes or streams, or any of the streams that feed into the park (Weeks and Andrascik 1998). The Minnesota Pollution Control Agency is responsible for water quality in the state, and it administers provisions of the Clean Water Act under the supervision of the Environmental Protection Agency. The Safe Drinking Water Act (1972; 42 USC 300 (f)-(j)) requires that water in Rainy Lake used for municipal drinking water comply with all federal, state, and local primary drinking water regulations. Standards for either the protection of aquatic life or drinking water have been set by Environmental Protection Agency for acidity and for many substances, including zinc, nickel, copper, cadmium, and dissolved oxygen.

NPS *Management Policies* indicate water in the park should be maintained in its natural conditions, free of pollutants generated by human activity (NPS 1988c, 4:15–16).

A dam at the outlet of Rainy Lake at International Falls / Fort Frances is owned and operated by Boise Cascade Corporation and Abiti Corporation for the generation of electricity. Water levels in the parks large lakes are regulated by the International Joint Commission, which was established by a treaty between the United States and Canada.

Environmental Consequences — Alternative 1

Analysis

Impacts Related to Overnight/Day Use. The use of overnight or day use sites, particularly those that do not have vault toilets, can result in human waste or leaching from pit toilets washing into waterbodies. Most pit toilets in the lakecountry have been replaced with vault toilets, and all remaining in the lakecountry are scheduled for replacement in 2000. Compared to the volume of the lakes, the reduction in biological oxygen demand or increase in nutrients or bacteria associated with these actions are a negligible impact to water quality.

Impacts Related to Other Development. The development of additional lakeshore campsites, campgrounds, visitor center facilities, and trails would result in erosion as described under “Soils,” which would in turn increase turbidity. At-large camping in both the lakecountry and backcountry by houseboaters, primitive campers, and overnight tent campers could result in soil loss through vegetative trampling and compaction of soils. Erosion would increase turbidity in drainages leading into both the large and interior lakes. The extent of either problem is unknown, but likely to be restricted to the lakeshore areas themselves and minor on a parkwide basis because of this restriction. Boats may also adversely affect water clarity as sediments are stirred up, particularly in shallower waters. This impact is negligible in depths greater than 10 feet (3 m), but may be detectable, and therefore a minor impact, in shallow water (Asplund 1996).

Impacts Related to Houseboat Graywater. Given the assumptions stated in the "Methodologies for Analyzing Impacts" section, the amount of graywater dumped per houseboat would equal 1,260 gallons (4,763 liters) in a given summer. This translates into 53,000 gallons (200,340 liters) dumped into Rainy Lake and 63,000 gallons (238,140 liters) into the lakes of the Namakan Basin. This is a tiny fraction of the lake volume in both cases (both basins are billions of gallons) and a negligible impact to water quality parkwide. However, graywater contains nutrients and suspended solids that could build up if houseboats moored in shallow bays for more than a few hours, with possible minor to moderate localized degradation, particularly to oxygen levels as a result. The park has not collected water quality data at sites where houseboats moor, but park staff note that graywater discharges are sometimes visible and have resulted in occasional public inquiries or critical comments (park staff, pers. comm. Nov. 1999). Current policy allows two houseboats to moor at developed sites, and many sites are purposely located in calm, shallow bays. Similar pollutants are added from pit toilets at campsites, or from undeveloped sites without toilet facilities.

Impacts Related to Recreational Use. Motorboats and, to a much lesser extent, floatplanes and snowmobiles (when lake ice melts in the spring) have the potential to emit hydrocarbons and even toxic breakdown products into the park's lakes. Again, no park-specific data on this potential problem have been collected, and many assumptions have been made to portray the most reasonable analysis of the impact of these sources to the park's water quality (see "Methodologies for Analyzing Impacts"). By applying these assumptions and methods to the U.S. side of Rainy Lake, motorized watercraft annually expel an average of 87,000 gallons (329,000 liters) of hydrocarbons (gas-oil mixture) into the lake. Assuming some percentage (5% per year) of motorboats switch to cleaner engines (manufacturers must produce only four-stroke or other cleaner technology by EPA order beginning in 2002), this would be reduced to 68,000 gallons (257,000 liters) per year by 2009. Even so, emissions from oil and gas discharged into Rainy Lake from motorboats would exceed 1.5 million gallons (5.7 million liters) over the life of the plan. The 1999 watercraft-hours for the U.S. side of the park's large lakes (MDNR unpublished data) show about 100,000 hours of use on Namakan, 45,000 on Sand Point, and 185,000 on Kabetogama. Over the 20-year life of the plan, fuel emitted from motorboat engines would result in about 1 million gallons (3.78 million liters) of oil-gas mixture in Namakan, 450,000 gallons (1.7 million liters) in Sand Point, and 1.8 million gallons (6.8 million liters) in Kabetogama. In addition to oil and gas from motorboats, a total of about 40 fueling stations on Rainy Lake, Ash River, and Kabetogama, including 6 park stations, exist. Many of these are quite small; however, leaks and spills occur throughout the warm months and cause minor localized and temporary increases in petroleum products in the immediate area.

The recommended limit for water used for a public water supply is that it be free of oil and grease. A 1991 study found some isolated measurements of as high as 4 mg/L in locations of Sand Point and Kabetogama Lakes (Payne 1991). Because no data on actual concentrations of oil or grease are available, the impact of motorized boat use on this element of water quality in the park is unknown. Some of the lighter elements of leaked fuel will volatilize, and heavier elements will sink and/or bind with soil particles, removing them from the water column. However, because standards have been exceeded in some locations, the potential for moderate to major adverse impacts to water quality remains.

Incidental releases of the carcinogenic fuel additive MTBE (methyl tertiary butyl ether) may also occur in park lakes. MTBE is added to fuel in some states to oxygenate it and increase performance. However, it is not added to fuels in Minnesota, although fuels used in the state may occasionally be tainted with MTBE picked up from pipelines transporting it from outside the state. Tainting may add as much as 0.5% MTBE (Carlson, pers. comm. 2000). Gasoline from neighboring states (e.g., Wisconsin) may contain MTBE as an additive. Also, although Canada does not require an oxygenate in its fuels in Ontario, it is possible but considered unlikely that some do contain it (Bower, pers. comm. 2000). Even if all fuel used by boats on the park's lakes contained fuel fully oxygenated with MTBE (at 8%), concentrations assuming watercraft hour figures above would not exceed recently adopted EPA advisory standards for drinking water. Therefore, no more than negligible effects to water quality from MTBE are expected.

The process of combusting fuel creates several different chemicals (called PAHs or polycyclic aromatic hydrocarbons), some of which have been identified as possible ecological toxins or human carcinogenic at very low concentrations (Agency for Toxic Substances and Disease Registry 1995). While some of the lighter of these compounds evaporate quickly, others persist in the water column and can pose a longer term threat to aquatic life. Others increase in toxicity in the presence of sunlight. The values various research studies have found to have no observed effect of PAHs on zooplankton or fish have ranged from 0.003 to 0.009 ppb (μg/L) (Oris et al. 1998). No data on PAH levels in park lakes are available; however, PAH levels in other reservoirs were directly correlated with the level of motorboat activity, and ranged from 4.12 μg/L to 18.86 μg/L total PAH concentration during periods of heavy boating (Mastran et al. 1994). These are well below EPA criteria for the protection of human health for certain PAHs, but well above the same criteria for other PAHs. Assuming PAH contamination in park lakes to be the same, impacts to parkwide water quality could be moderate to major, with major localized impacts possible where motorboat use is concentrated and water is relatively stagnant. Impacts to human health depend on the regular consumption of fish and water from the lake.

Boat tours take place on Rainy Lake and in the Kabetogama–Namakan basin; however, these boats are on the water about 60 hours per week for a 12-week period, releasing about 2,000 gallons (7,500 liters) of oil/gas mixture into the lake per year. Motorized boats would continue to be allowed on seven interior lakes under alternative 1; however, only incidental motorized boat use occurs on any of the interior lakes except Mukooda. Four commercial motorized boats and an unknown number of private boats use Mukooda Lake. Emissions from the four commercial boats (assuming use statistics similar to those for houseboats, and that all four commercial boats have 25HP two-stroke engines) would add about 780 gallons (2,950 liters) of oil-gas mixture to Mukooda Lake each year.

Private floatplanes are allowed to land on seven interior lakes and all four major lakes in the park, and two commercial airplane pilots hold permits to fly into Kettle Falls and Shoepack Lake, respectively. Although floatplane engines can discharge small amounts of fuel, they are four-stroke. Floatplane use in the park is also substantially smaller than any other type of motorized use and does not total more than about 50–75 flights from private planes, 50–60 from commercial round-trips, and an average of one trip per day (or about 500 hours/year) from the park's floatplane throughout the warm season (Hablett, pers. comm. 2000). Therefore, impacts to water quality from floatplanes are assumed to be negligible.

Cumulative Impacts

None of the alternatives would alter anything about snowmobiling in the park. No trails would be developed or removed, and no restrictions beyond those imposed now are anticipated in any alternative. Therefore, snowmobiling and its impacts to air or water quality are considered outside the study area and fall into the "cumulative impact" category, as they have additive effects on water quality.

Snowmobiling in the park is a rapidly increasing winter recreational activity, and observations by park staff indicate the majority of in-park snowmobile use occurs on Kabetogama Lake. While little research has been conducted on the impacts to water quality of snowmobile use, snowmobiles use the same two-stroke engine as do motorboats, and they emit similar types and quantities of oil-gas mixtures and hydrocarbon compounds such as PAHs (Ingersoll 1999). It is unknown how much of this discharged fuel remains when spring arrives, or how exposure to air, cold, and other conditions interact with the fuel or its components. Sulfate and ammonium have also been found in melted snow samples at Yellowstone National Park in concentrations that were consistently higher along snowmobile trails and decreasing as distance from the trail increased (Hagemann and VanMouwerik 1999). Water quality sampling in the park in 1980 and 1981 did find ammonium and sulfide at levels higher than standards for the protection of aquatic life in Black Bay and Ash River (Payne 1991). Because the park is host to nearly 30,000 snowmobilers per year, the majority of whom use the ice of Rainy and Kabetogama Lakes to travel, impacts from this source have the potential to be locally moderate or severe, particularly in the spring when pulses of pollutants are dumped into the lakes. Without data, however, the impact is unknown.

Oil, grease, and other substances are washed into the park's lakes from roads and parking lots as well. This, too, has a cumulative but negligible impact when combined with the effects of motorized boats on water quality.

Septic releases from park neighbors is also a cumulative impact, as its effects are additive with those inside the park, particularly from houseboats. As noted by the St. Louis County Environmental Health Department, "In northeastern Minnesota we have seen an increase in the level of lakeshore property use as well as a modernization of facilities without improving the sanitary systems to meet those increased needs" (St. Louis County to NPS Water Resources Division, Jan, 27, 1998). Surveys of downstream communities, including Rainy Lake and Jackfish Bay, indicate 35% of septic owners have detected seepage from their septic systems (A. W. Research Laboratories 1997). Most of the septic systems in these communities are within 100 feet of Rainy Lake (Olson, pers. comm. 1999). The characteristics of septic releases are similar in nature to graywater releases from houseboats, but nutrients and suspended solids, and the impact on oxygen in water, is at least double that of graywater alone (A. W. Research Laboratories 1997). Although the leakage in readily apparent, the impact of the leakage has not been, and is not, measured. Therefore the impacts are unknown, but potentially negligible to moderate.

No alternative would attempt to manage lake levels differently than others, although all alternatives include provisions for partnerships with neighboring entities to encourage resource protection. An example of this partnership is the ongoing cooperative effort between several agencies, private landowners, and others to work toward reestablishing more natural lake levels in the park's regulated lake basins. As a result of this effort, the International Joint Commission has released a supplementary order that will provide more natural hydrological conditions on Namakan Reservoir. Historically, the regulation of lake levels has resulted in altered magnitude and timing of water level fluctuations, removing much of the natural hydrologic variability the lakes would normally experience (Weeks and Andrascik 1998). Under the 1970 order, the average annual lake fluctuations have been 2.7 meters for Namakan Reservoir and 1.1 meters for Rainy Lake. This level of fluctuation is 0.9 meter greater than before the dams were built for Namakan Reservoir and 0.8 meter less for Rainy Lake. Lake levels have also peaked later (in late June or early July) than under natural conditions (late May or early June) and remained stable throughout the summer instead of gradually declining. This has had a major impact on the natural hydrology of the park. Under the new 2000 order, the allowable overall fluctuation on Namakan Reservoir has been reduced to 2.0 meters, water levels will peak earlier, and there will be a summer drawdown. On Rainy Lake, the existing rule curve was widened slightly in the spring, and there will be a modest late summer drawdown. Despite these changes, continued regulation of both reservoirs will maintain less than natural variability.

Conclusion

Dissolved oxygen or nutrient levels in the park's large lakes is affected in negligible amounts by human waste washing in from undeveloped sites, remaining pit toilets, or graywater from houseboats. Houseboats moored for longer periods of time in shallow bays could have minor to moderate localized adverse impacts on dissolved oxygen or nutrient levels. Failing septic systems on property adjacent to Rainy Lake (and presumably other large lakes since geologic and soil conditions are similar) add to this impact. Oil and grease standards for drinking water could be exceeded lakewide at times on the park's large lakes from motorboat exhaust emissions, fueling stations, or even snowmobiles; some individual measurements indicate these standards have been exceeded. The impact to the park's large lakes is unknown, but the potential for minor or moderate impacts exists. Incidental releases of MTBE from motorboats are also possible, although no standard would be exceeded. Fuel combustion also creates PAHs, which are ecological toxins or human carcinogens at very low concentrations. Compared to other lakes with similar motorboat use levels, there is potential for major localized and moderate to major parkwide water quality impacts from PAHs. Snowmobiles, particularly on Kabetogama Lake, could have substantial cumulative effects on oil and grease or PAH levels, but many unknowns preclude analysis. Snowmobiles might also increase ammonium or sulfate levels in park lakes. Dam construction and operation on the park's major lakes has resulted in major changes in magnitude and timing of water level fluctuations, as well as a major reduction in natural hydrologic variability as a result of water level management to maximize hydropower output. Minor to major benefits to hydrology from the implementation of the new International Joint Commission supplemental order could occur.